

THE GENUS *CENTRUROIDES* IN SOUTH AMERICA (SCORPIONES, BUTHIDAE)

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ABSTRACT

The systematics of the genus *Centruroides* Marx, 1889, in South America is reviewed. Three taxa are retained as valid: *C. gracilis* (Latreille), *C. margaritatus* (Gervais), and *C. exsul* (Meise). Of these, *C. margaritatus* is redescribed, based on the rediscovery of the holotype female from Isla Puná, Ecuador. Three new synonymies are proposed: *Centruroides dasypus* Mello-Leitão, 1948 = *Centruroides vittatus* (Say, 1821); *Centruroides argentinus* Werner, 1939 = *Centruroides margaritatus* (Gervais, 1841); and *Centruroides danieli* (Prado and Rios-Patiño, 1939) = *Centruroides margaritatus* (Gervais, 1841).

RESUME

La systématique du genre *Centruroides* Marx, 1889, est révisée pour l'Amérique du Sud. Trois taxa sont retenus comme valables: *C. gracilis*, *C. margaritatus* et *C. exsul*. *Centruroides margaritatus* est redécrit en se fondant sur l'holotype femelle de l'île de la Puná, en Equateur. Trois nouvelles synonymies sont proposées: *Centruroides dasypus* Mello-Leitão, 1948 = *Centruroides vittatus* (Say, 1821); *Centruroides argentinus* Werner, 1939 = *Centruroides margaritatus* (Gervais, 1841); et *Centruroides danieli* (Prado et Rios-Patiño, 1939) = *Centruroides margaritatus* (Gervais, 1841).

INTRODUCTION

The buthid genus *Centruroides* Marx, 1889, is one of the most complex scorpion genera in the New World, and is widely distributed in North America, the Antilles, and Central America. Six species are recognized from South

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America and associated islands. Although a generic revision of *Centruroides* is badly needed, the South American taxa, in particular, have not been collectively studied since Mello-Leitão's (1945) monograph. In the present study we reevaluate the taxonomic status of the six species of *Centruroides* and their synonyms in South America, based on the examination of type material for most of the nominal taxa.

Among the specimens of the Gervais collection is an adult female from Isla Puná, Ecuador which almost certainly is the original type specimen of *Scorpio margaritatus*. The rediscovery of this specimen is of considerable taxonomic importance, as *C. margaritatus* is a highly variable, widespread, and poorly understood species, occurring from Mexico to South America and the Antilles. A complete redescription of *C. margaritatus* is given here based on this adult female.

Centruroides gracilis (Latreille, 1804)

Figs. 1-10

Scorpio australis, DeGeer 1778:248.

Scorpio gracilis Latreille 1804:127.

Scorpio biaculeatus, Gervais 1843:130 (nomen nudum).

Scorpio (Atreus) biaculeatus Gervais 1844a:54; 1844b:218; 1857:43.

Centrurus biaculeatus, Thorell 1877:166.

Centrurus gracilis, Karsch 1879a:18; Kraepelin 1891:131; 1894:95; 1899:92; 1905:339, Pocock 1893:385; Penther 1913:243.

Centruroides gracilis, Pocock 1902:32; Hoffman 1939:323; Werner 1934:274; Mello-Leitão 1945:257; Caporiacco 1951:3; Scorza 1954a:165; 1954b:160; 1954c:200; Bücherl 1959:267; 1971:327; Stahnke and Calos 1977:112; Wagner 1977:45; Francke and Wagner 1978:159; González-Sponga 1984:66.

Rhopalurus gracilis Meise 1934:30 (part).

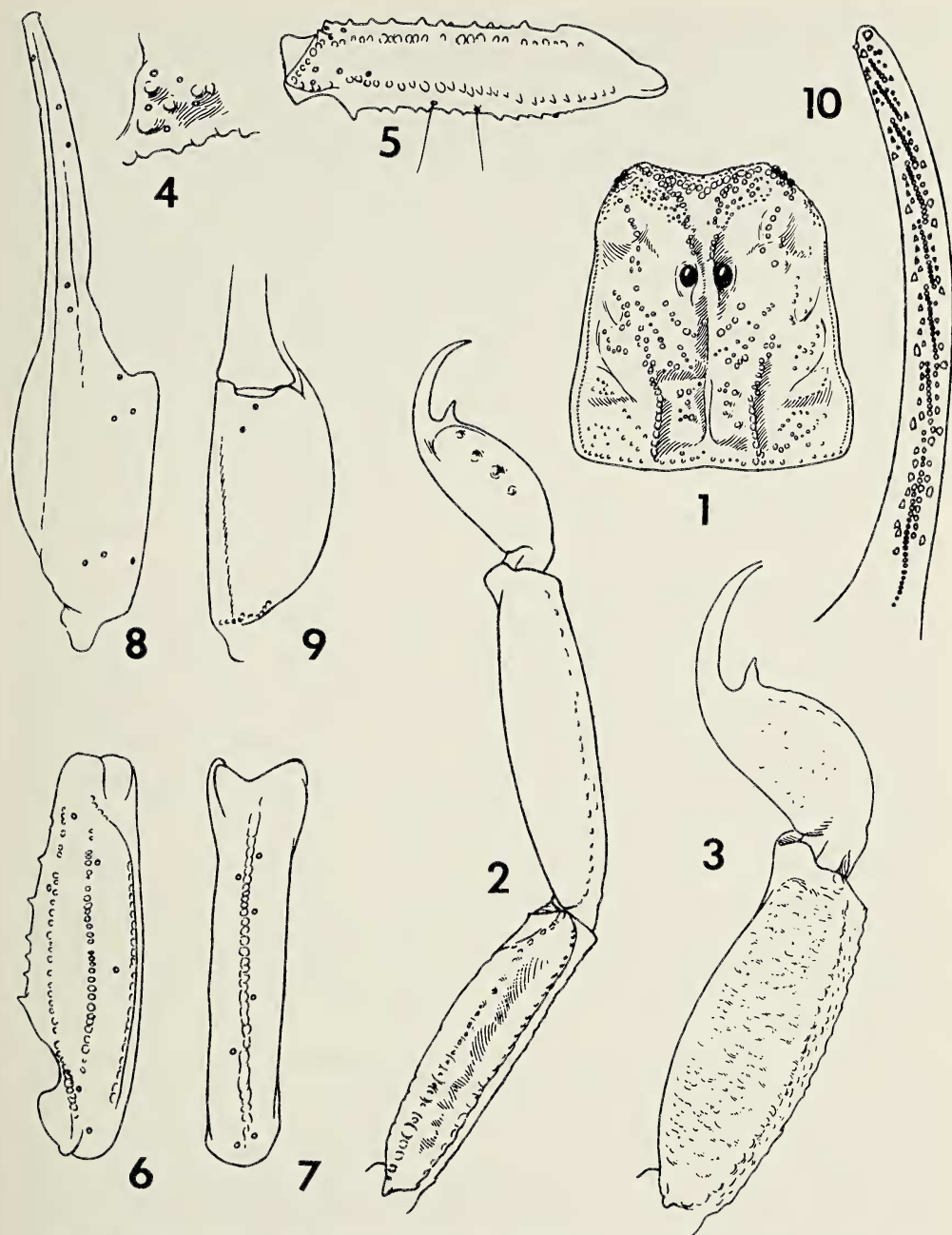
Note: The above synonymy reflects usage of names as applied to South American specimens and other relevant citations.

Type data.—Latreille (1804) created the name "*Scorpio gracilis*" for specimens that DeGeer (1778) had referred to *Scorpio australis* Linnaeus. Apparently, he never examined these specimens and did not designate a holotype; however, DeGeer's specimens must be regarded as the types of *S. gracilis*. T. Kronstedt (pers. comm., Mar. 1986) indicates that two pinned specimens of *Scorpio australis* from DeGeer's collection are currently housed in the Naturhistoriska Riksmuseet.

The types of *Scorpio (Atreus) biaculeatus*, presumably deposited in the MNHN (Paris) were not located in that collection and are almost certainly lost.

In conjunction with this study of *C. gracilis*, we have also attempted to locate and examine other synonyms previously referred to this species. The types of *Androctonus biaculeatus* Lucas (MNHN), *Tityus mulatinus* Koch (ZMB), *Tityus congener* Koch (ZMB), and *Tityus nebulosus* Koch (ZMB) are no longer in their respective depositories and are almost certainly lost. The types of *Centrurus heterurus* Karsch and *Tityus macrurus* Koch, both deposited in the Zoologisches Museum (Berlin), were examined and are referable to *C. gracilis* (see also Francke and Wagner 1978).

Distribution.—*Centruroides gracilis* is widely distributed in the Neotropical Region, known from the U.S.A. (southern Florida), much of Mexico, Central America, Cuba, and northern South America. It is also a commonly introduced species in other tropical areas. In South America, the species occurs in Venezuela



Figs. 1-10.—Morphology of *Centruroides gracilis* (Latreille): 1, carapace of male; 2, distal end of metasoma and telson of male; 3, metasomal segment V and telson of female; 4-9, trichobothrial pattern of pedipalp; 4, proximal end of internal face of femur; 5, dorsal view of femur; 6, dorsal view of tibia; 7, external view of tibia; 8, external view of chela; 9, ventral view of chela; 10, movable finger of pedipalp chela, showing dentition.

(González-Sponga 1984); we have seen a few specimens labeled "Columbia" and "Ecuador", but these represent old and, possibly, unreliable records.

Description.—Large species of *Centruroides*, adults up to 110 mm in length. Color of carapace, tergites, and metasoma dark reddish brown to dark brown; legs yellow brown; pedipalp femur and tibia yellow brown, chela manus reddish

brown with fingers slightly darker. Carapace (Fig. 1) with dense, coarse (but rounded) granulation. Mesosoma: median keel on I vestigial; on II weak, granular; on III-VI moderate to strong, granular. Tergite VII with median keel weak to moderate, granular; lateral keels moderate to strong, crenulate. Sternite VII tetracarinate, with submedian pair of carinae weak, smooth; lateral pair moderate, finely granular. Pectinal tooth counts 29-35 in males, mode 31-32; 27-30 in females, mode 29.

Metasomal segments I-IV: Carinae in males moderate, finely crenulate to crenulate, except as follows: Ventrolaterals granular on I-II; ventral submedians weak on I-IV, smooth to finely granular on I-II, finely crenulate on III-IV. Metasomal carinae of female as in male, except crenulations, where present, typically more coarse. Segment V (Figs. 2, 3): Male with dorsolateral and lateromedian carinae obsolete; ventrolateral and ventromedian carinae weak, smooth to finely granular. Female with dorsolateral carinae weak, finely granular; lateromedian carinae obsolete; ventrolateral and ventromedian carinae weak, finely crenulate.

Telson with subaculear tooth strong, spinoid, directed away from aculeus (Fig. 2, 3).

Pedipalps: Orthobothriotaxia A (Figs. 4-9), femur with α configuration (Figs. 4, 5). Chela (Figs. 8-10) with digital carina vestigial on palm, weak and smooth on fixed finger; ventroexternal carina weak; finely granular in males, smooth in females; dorsointernal carina weak, finely granular; all other chela carinae obsolete. Fixed finger with nine oblique rows of denticles (or eight when basal rows fused); movable finger (Fig. 10) with nine oblique rows of denticles (eight when basal rows fused) plus a short apical row of four granules; supernumerary granules present in later instars. Inner margins of chela fingers subtly scalloped. Chelicerae: fixed finger ventrally with one nodule.

Variation.—The most notable variation occurs in pectinal tooth counts (Table 2) and pedipalp chela finger dentition (Table 3). *Centruroides gracilis* typically has nine oblique rows of granules on the chela fixed finger, but many South American specimens have the two basalmost rows fused. Fusion of the basalmost rows on the movable finger also occurs. In such cases, it appears that only eight rows are present.

Coloration, which is quite variable in other parts of the range of this species, is rather consistent among South American specimens. The specimens we have examined are dark reddish brown with yellow brown legs and lighter reddish brown pedipalps. The chela manus is considerably lighter than the fingers. This color scheme is quite similar to that found in Central American specimens. In Mexico and Florida (USA), however, there is considerable variation, with specimens tending to be blackish with gray-brown legs (Hoffman 1932; pers. obs.). The taxonomic importance of this color variation in *C. gracilis* is poorly understood, and any future analysis of it must necessarily incorporate the close relatives of *C. gracilis* in Central America.

Specimens examined.—VENEZUELA: no specific locality, 25 Feb. 1892 (Meinert), 4 females (ZMR); Caracas, 8 June 1891 (Meinert), 1 male (ZMR); no specific locality, 1 male, 1 female RS-1065 (MNHN); San Fernando de Apure, 5 Oct. 1897 (L. Leglaise), 1 male, 3 females, RS-1053 (MNHN); no specific locality, 1899 (M. Maindron), 1 male, RS-1067 (MNHN); El Vigia, Depto. Vargas (A. R. Lancini, det.), 1 male (IB-Sc-896).

Table 1.—Measurements in mm of *Centruroides* spp. from South America, including the type specimens of *C. argentinus* Werner and *C. danieli* Prado and Rios-Patiño.

	<i>C. gracilis</i>		<i>C. margaritatus</i>		<i>C. danieli</i>		<i>C. argentinus</i>		<i>C. exsul</i>	
	Male Coiom.	Female Colom.	Male Colom.	Female holotype	Male holotype	Female holotype	Male paratype	Female holotype		
Total length	108.2	86.5	99.7	79.1	92.8	53.9	?	?		
Carapace length	9.1	8.6	8.5	9.0	8.3	5.8	?	5.4		
Anterior width	5.9	5.5	5.7	5.9	5.5	4.2	?	3.7		
posterior width	8.7	8.8	8.9	9.8	8.8	6.4	?	5.9		
Mesosoma length	27.7	27.8	23.4	20.3	21.7	15.5	?	15.7		
Metasoma length	71.4	50.1	67.8	49.8	62.8	32.6	26.0	?		
I length	9.0	6.7	9.4	6.7	9.1	4.2	3.3	3.9		
I width	4.1	4.4	4.4	5.5	4.5	3.3	2.7	2.9		
II length	11.8	8.0	11.7	7.7	10.6	5.2	4.0	4.5		
II width	4.0	4.3	4.3	5.4	4.4	3.2	2.5	2.7		
III length	13.0	8.7	12.5	8.6	11.2	5.5	4.2	4.7		
III width	4.0	4.2	4.3	5.3	4.3	3.2	2.5	2.7		
IV length	12.9	8.5	12.2	8.4	10.8	5.5	4.2	4.7		
IV width	3.8	4.2	4.3	5.2	4.2	3.2	2.5	2.7		
V length	14.0	9.5	12.8	9.7	12.0	6.2	5.0	5.5		
V width	4.0	4.1	4.3	5.0	4.1	3.2	2.3	2.5		
V depth	3.8	3.7	4.0	4.4	3.7	2.8	2.2	2.3		
Telson length	10.7	8.7	9.2	8.7	9.1	6.0	5.3	?		
Vesicle length	7.8	5.7	6.5	5.4	6.4	3.5	3.3	?		
Vesicle width	3.7	3.1	3.8	3.4	3.6	2.3	1.9	2.0		
Vesicle depth	3.4	2.9	2.6	2.9	2.7	2.0	2.0	2.0		
Aculeus length	2.9	3.0	2.7	3.3	2.7	2.5	2.0	?		
Pedipalp length	38.4	32.2	35.9	32.9	35.3	23.2	20.1	22.3		
Femur length	10.4	8.5	9.7	8.5	9.5	5.7	5.0	5.5		
Femur width	2.3	2.2	2.3	2.3	2.3	1.9	1.5	1.6		
Tibia length	10.6	8.8	10.0	9.1	9.7	6.4	5.5	6.2		
Tibia width	3.0	2.9	2.9	3.2	2.9	2.6	2.0	2.2		
Chela length	17.4	14.9	16.2	15.3	16.1	11.1	9.6	10.6		
Chela width	3.7	3.2	4.0	3.7	3.4	2.9	2.2	2.5		
Chela depth	3.5	3.1	4.8	4.3	4.0	2.6	2.1	2.4		
Mov. Fing. length	10.6	9.7	9.7	9.5	10.1	7.3	6.3	6.8		

Centruroides margaritatus (Gervais, 1841)

Figs. 11-31

Scorpio margaritatus Gervais 1841:281; 1844a:55.
Scorpio (Atreus) margaritatus, Gervais 1843:130; 1844b:224.
Scorpio (Atreus) edwardsii, Gervais 1843:130; 1844b:216; 1857:41; Thorell 1877:167.
Scorpio edwardsii, Gervais 1844a:53.
(?) *Scorpio degeeri* Gervais 1843:130; 1844a:54.
(?) *Scorpio (Atreus) degeeri*, Gervais 1844b:217.
Centrurus degeeri, Thorell 1877:167; Kraepelin 1891:133.
Centrurus (Atreus) degeeri, Karsch 1879b:124.
Centrurus (Atreus) edwardsii, Karsch 1879b:124.
Centrurus margaritatus, Pocock 1893:386; Kraepelin 1899:93; 1984:95; 1905:339; Borelli 1899:11; Penther 1913:240.
Centruroides margaritatus, Pocock 1902:30; Kraepelin 1914:22; Werner 1934:274; Mello-Leitão 1940:51; 1945:260; Scorza 1954b:160; 1954c:201; Bücherl 1959:268; 1971:327; Aguilar & Meneses 1970:3; Stahnke & Calos 1977:112.
Rhopalurus margaritatus, Meise 1934: 40 (part).

Table 2.—Variation in the number of pectinal teeth among species of *Centruroides* in South America. Only adults are used in the analysis.

No. Teeth:	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
MALES:																	
<i>C. exsul</i>			2			2	2	3	1								
<i>C. gracilis</i>											1	4	5	5	3	1	1
<i>C. margaritatus</i>							7	11	21	17	14	5	8	3	2		
FEMALES:																	
<i>C. exsul</i>	6	5	3	1	6	3											
<i>C. gracilis</i>									2	5	10	7					
<i>C. margaritatus</i>					3	13	33	51	12	16	2						

Rhopalurus danieli Prado & Rios-Patiño 1939:42; Prado 1939:28. **NEW SYNONYMY.**

Centruroides danieli, Mello-Leitão 1940:51; 1945:253; Bücherl 1959:268; 1971:327; Stahnke & Calos 1977:112. **NEW SYNONYMY.**

Centruroides argentinus Werner 1939:357; Mello-Leitão 1945:252; Weidner 1959:99; Abalos 1963:111; Maury 1979:705; Stahnke and Calos 1977:112. **NEW SYNONYMY.**

Type data.—Holotype female of *Scorpio margaritatus* Gervais, 1841, from Isla Puná, Ecuador (Eydux and Souleyet). Deposited in the Muséum National d'Histoire Naturelle, Paris; examined.

The types of *Scorpio edwardsii* Gervais were not positively identified among the collection of the MNHN. We have examined some material labeled "*Centrurus edwardsii* Gervais" which may be part of the old Gervais collection. Because the identity of these specimens is questionable, we will not designate a lectotype.

Likewise, the types of *S. degeeri* Gervais were not identified among MNHN material, although they are presumably deposited there. Specimens used in the original description reportedly originated from Colombia and Chile (Gervais 1844a,b). All Colombian *Centruroides* we have seen are referable to *C. margaritatus*, but no reliable records of that genus from Chile have been obtained in the nearly 150 years since the original description. We have chosen, therefore, to follow earlier workers and retain *Scorpio degeeri* as a probable synonym of *C. margaritatus*.

The types of *Tityus carinatus* Koch and *Tityus ducalis* Koch, long considered synonyms of *C. margaritatus*, are lost from the Zoologisches Museum, Berlin (M. Moritz, pers. comm.); these synonymies cannot be confirmed.

The types of *Rhopalurus danieli* Prado & Rios-Patiño (male holotype and three male paratypes, IB-Sc-54-57) from Colombia, Andes Colombianos, 26.VI.1936 (H. Daniel) were examined and determined to be conspecific with *C. margaritatus* (see Comments). They are permanently deposited in the Instituto Butantan, São Paulo.

The type female of *Centruroides argentinus* Werner from Campo Santo (Prov. Salta), Argentina, 20.XII.1908 (J. Schmidt), deposited in the Zoologisches Museum, Hamburg, was examined and determined to be a subadult female of *C. margaritatus* (see Comments).

Distribution.—*Centruroides margaritatus* is widely distributed in the Neotropical Region, being recorded from parts of México, Central America, several Antillean Islands (Cuba, Jamaica, and Hispaniola), and northern South America. In South America, *C. margaritatus* occurs in Colombia, Ecuador, Venezuela, and

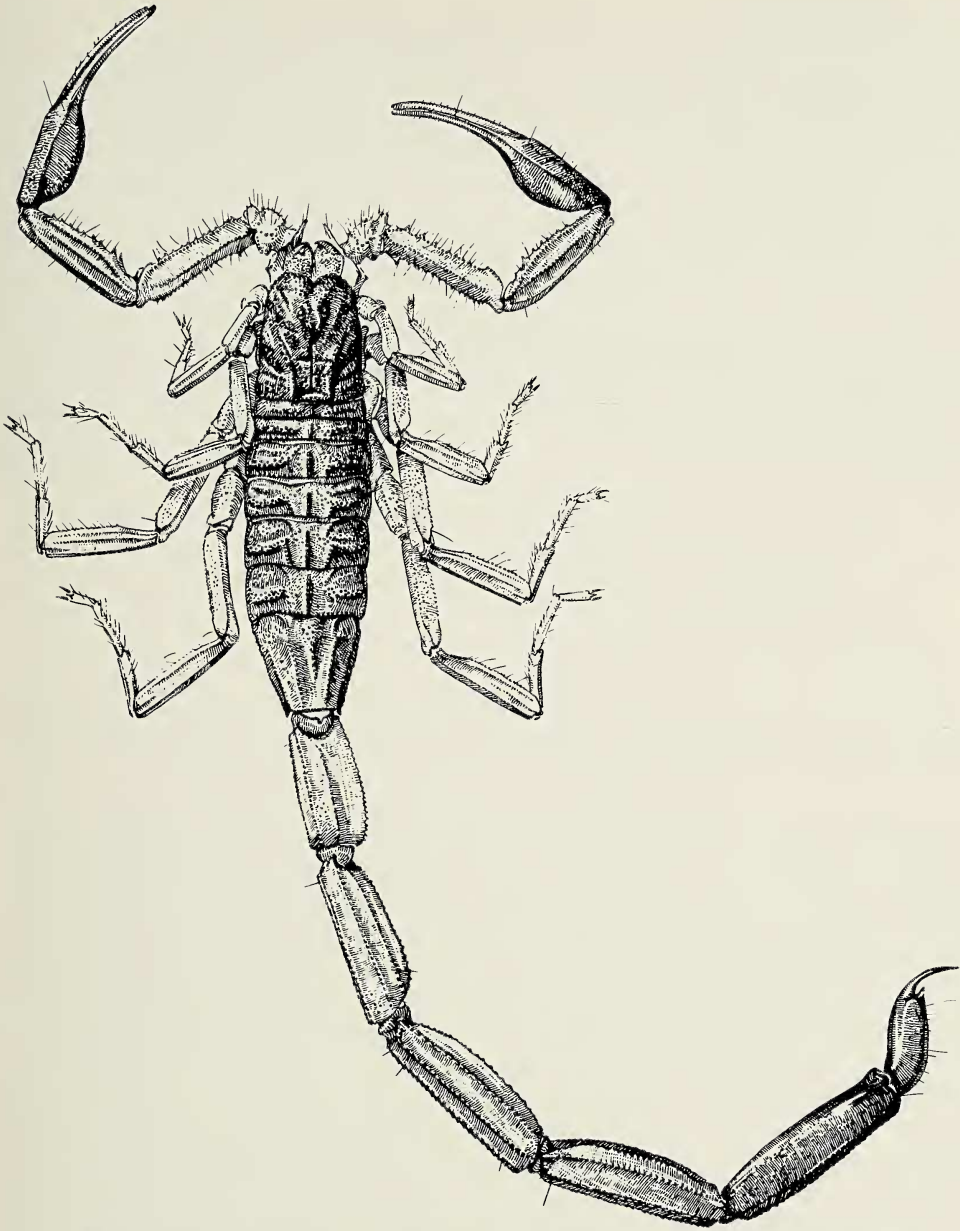
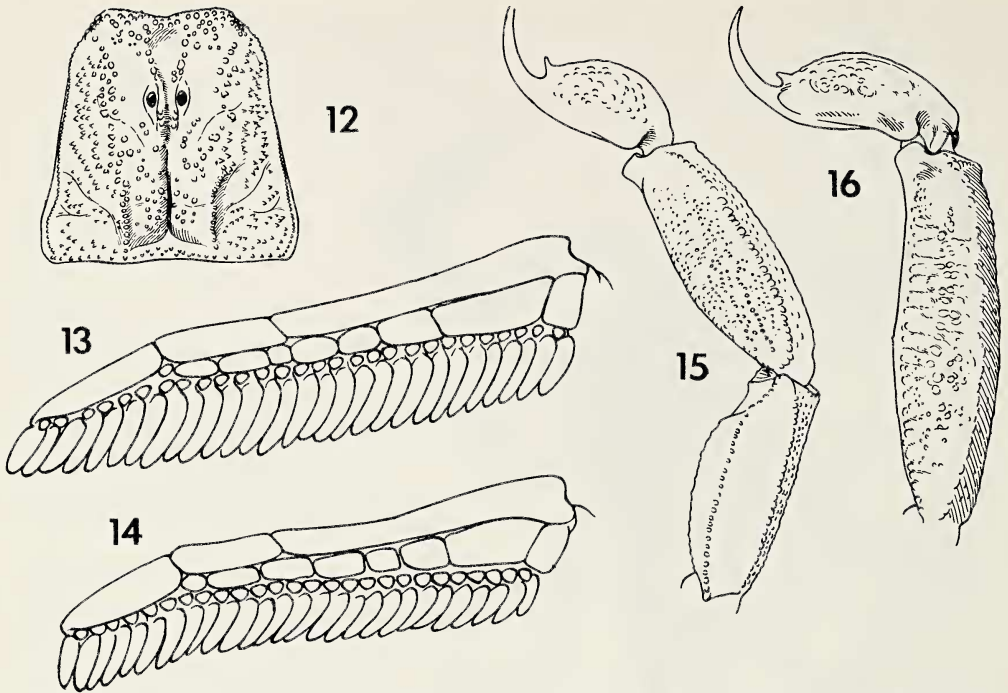


Fig. 11.—Dorsal view of male *Centruroides margaritatus* (Gervais) from Colombia.

possibly Peru. We have also seen a few labeled specimens from Bolivia, Brazil, Chile, and Paraguay, but it is unlikely that the species occurs there.

Redescription.—The following is a complete redescription of the holotype female from Isla Puná, Ecuador. Morphology of an adult male and female from Colombia is illustrated, and figure references in the description refer to those specimens. Male characters are discussed separately (see Variation). Measurements of the holotype and an adult male are given in Table 1.

Prosoma. Carapace (Fig. 12) dark yellow-brown with variable underlying dusky markings; granulation dark brown; ocular tubercle black. Anterior median,



Figs. 12-16.—Morphology of *Centruroides margaritatus* (Gervais): 12, carapace of male; 13, right pectine of male; 14, right pectine of female; 15, distal segments of metasoma and telson of female; 16, metasomal segment V and telson of male.

superciliary, and posterior median keels moderate, composed of large, rounded granules; remainder of carapace with moderately dense, rounded granules. Anterior median furrow moderately deep, ovate; posterior median furrow narrow, shallow anteriorly, deep posteriorly; posterior marginal furrows narrow, deep; posterior lateral furrow shallow, wide, curved. Venter yellow-brown with dark brown tinging; coxal gnathobases orange-brown. Sternum subtriangular, median longitudinal furrow Y-shaped, shallow anteriorly, deep and narrow posteriorly.

Mesosoma. Tergites dark yellow-brown with underlying fuscous pattern; VII lighter than preceding segments; granulation dark brown. Tergites I-VI: pretergites shagreened; post-tergites with moderately dense, coarse, rounded granules. Median keel on I weak, composed of several small granules; on II weak, composed of distinct rounded granules; on III-VI moderate with larger rounded granules. Tergites III-VI with pair of indistinct lateral keels. Tergite VII: granulation as in I-VI; pentacarinat, all keels strong, crenulate. Venter: Genital operculum completely divided longitudinally; genital papillae absent. Pectines (Figs. 13-14): basal piece subrectangular with distinct anteromedian notch; pectinal tooth count 28-29. Sternites yellow-brown with dark brown tinging; III-VI smooth, with elongate stigmata; VII with four moderate keels, median pair smooth, lateral pair finely crenulate.

Metasoma. Segments I-III yellow-brown; IV yellow-brown proximally, dark brown distally; V dark reddish brown. Ventral aspect of all segments darker than dorsal aspect; metasomal carinae dark brown. Segments I-IV: dorsolateral and lateral supramedian keels strong, crenulate. Lateral inframedian keels on I complete, strong, crenulate; on II-III represented by only two to three distal

granules; on IV absent. Ventrolateral keels strong, crenulate. Ventral submedian keels on I moderate, finely crenulate; on II-IV strong, crenulate. Intercarinal spaces with scattered fine granules. Segment V (Figs. 15-16): dorsolateral keels moderate, granular; lateromedian keels obsolete; ventrolateral and ventromedian keels strong, crenulate. Lateral intercarinal spaces coarsely granular, dorsal and ventral spaces finely granular.

Telson (Figs. 15-16). Dark reddish brown. Moderately globose, with strongly curved aculeus. Dorsal surface rounded, smooth; ventral surface coarsely granular. Subaculear tooth moderate, spinoid, directed more towards base of aculeus.

Chelicerae. Yellowish with dark brown mottling on dorsal surface of manus; fingers and teeth dark brown. Dentition as in other *Centruroides*. Fixed finger ventrally with one nodule. Ventral aspect of both fingers and manus with dense, long setae.

Pedipalps. Femur (Figs. 17-18, 23-24) medium brown, lighter than body; carinae dark brown. Tetracarinate: dorsointernal and ventrointernal carinae strong, crenulate; dorsoexternal carina strong, serrate. External carina vestigial, with strong, sharp granules distally. Internal face with about 15 moderate conical granules; other faces shagreened. Orthobothriotaxia A, configuration α .

Tibia (Figs. 19-20, 25-26): Medium brown, lighter than body; carinae dark brown. Hexacarinate: dorsointernal carina moderate, finely serrate. Dorsomedian, dorsoexternal, and external carinae moderate, granular. Ventroexternal carina moderate, granular. Ventrointernal carina moderate, with irregularly spaced large granules. Internal face with moderate basal tubercle; with about 10 moderate conical granules; other faces shagreened. Orthobothriotaxia A.

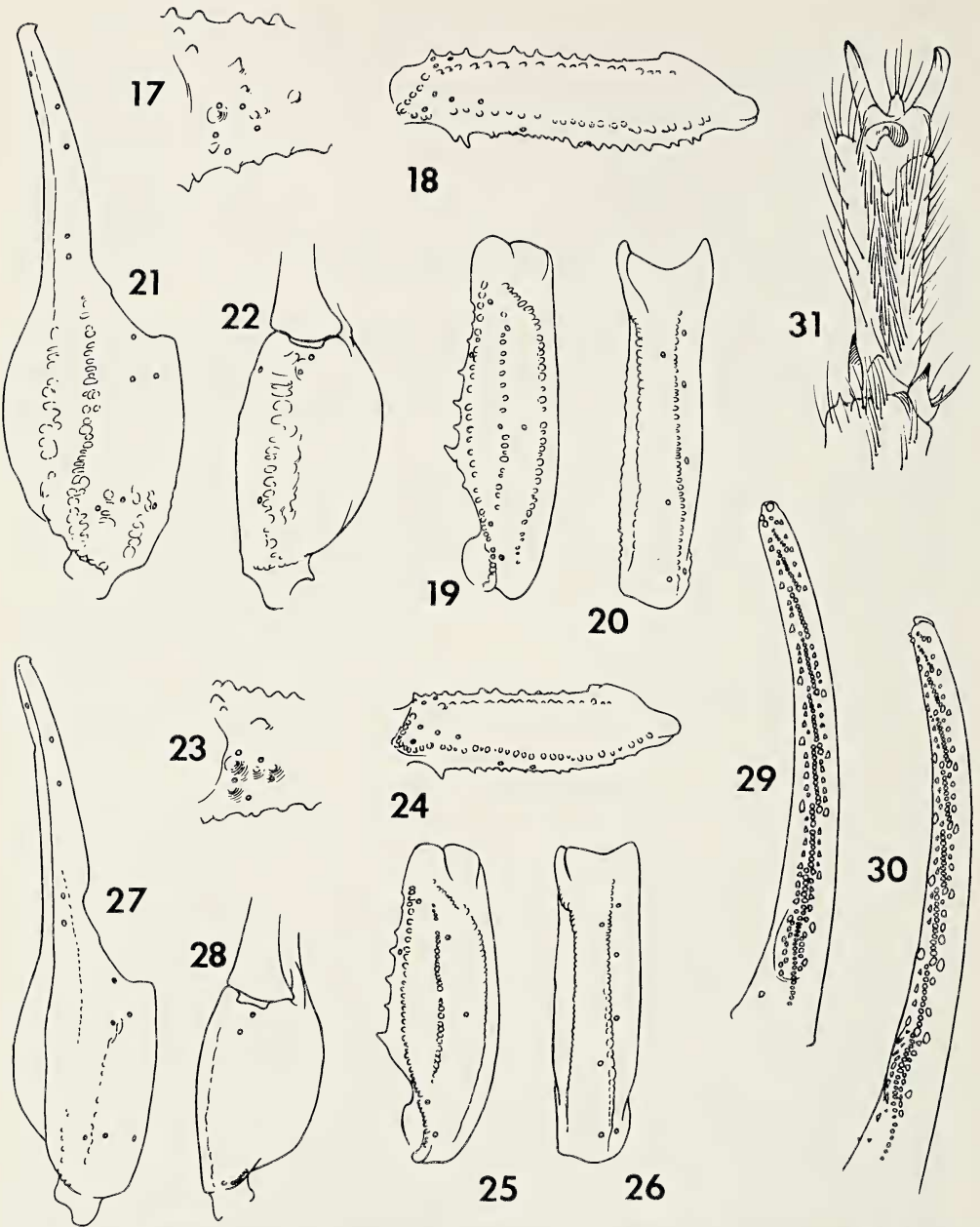
Chela (Figs. 21-22, 27-30): Palm reddish brown on outer surface, yellowish on inner surface; carinae dark brown. Fingers reddish brown basally, yellowish distally; dentate margins dark brown. Dorsal marginal carina weak, smooth. Dorsal secondary carina moderate, smooth. Digital and ventroexternal carinae strong, granular. External secondary carina incomplete, moderate, granular. Ventromedian carina strong, smooth. Ventrointernal and dorsointernal carinae weak, finely granular. External face with short, granular, basal accessory carina. Fixed finger typically with eight oblique rows of granules; movable finger (Figs. 29-30) typically with eight oblique rows plus a short apical row of 4 granules. Supernumerary granules present. Orthobothriotaxia A.

Legs. Yellowish with variable underlying dusky markings. Tarsus ventrally with numerous short fine setae (Fig. 31).

Variation.—Variation in pectinal tooth counts is given in Table 2. Male pectinal tooth counts range from 25-33 (mode = 27); female counts range from 23-29 (mode = 26). Variation in pedipalp chela finger dentition is given in Table 3.

Males differ from females in the following characters: carapace and tergites with moderately dense, coarse, subconical granules, rather than rounded granules; anterior median, superciliary, and posterior median carapacial carinae strong, not moderate. Genital papillae present. Metasoma: carinae of I-IV moderate, crenulate, with granules widely spaced; all segments elongate, slender. Telson elongate oval with flattened dorsal surface.

There is considerable variability in cuticular granulation and pectinal tooth counts among populations in South America. Specimens in Ecuador and Peru have moderately dense granulation on the carapace and tergites and pectinal



Figs. 17-31.—Morphology of *Centruroides margaritatus* (Gervais): 17-22, pedipalps of males, showing trichobothrial pattern (see legend of *C. gracilis* for explanation); 23-28, pedipalps of females, showing trichobothrial pattern; 29, movable finger of male, showing dentition; 30, movable finger of female; 31, ventral aspect of tarsus of leg IV (female specimen).

tooth counts usually between 24-28. Specimens from Colombia (including specimens of the Gervais collection labeled as "*Centrurus edwardsii*") have more dense granulation and pectinal tooth counts above 27.

Comments.—*Centruroides margaritatus* is a widespread species, occurring from Mexico to northern South America and in the Antilles. There is a marked tendency for local populations to differ considerably from one another, leading

Table 3.—Variation in the number of oblique rows of granules on the inner margins of the pedipalp chela fingers. Movable finger counts do not include the short apical row.

	No. Rows Fixed Finger				
	6	7	8	9	
<i>C. exsul</i>	—	9	11	—	
<i>C. gracilis</i>	—	—	43	3	
<i>C. margaritatus</i>	2	113	18	—	
	No. Rows Movable Finger				
	5	6	7	8	9
<i>C. exsul</i>	—	—	13	7	—
<i>C. gracilis</i>	—	—	—	18	28
<i>C. margaritatus</i>	2	—	10	110	—

some authors to recognize subspecies (e.g., Hoffmann 1932, Mello-Leitão 1945). Unfortunately, records of the species throughout the range are rather patchy and specimens generally few in number, yielding a very poor understanding of the nature of the great variation exhibited. Until variation in this species is better known, the recognition of subspecies seems premature at best.

In South America, the problem is intensified. There are few specimens in museum collections, and what specimens exist often have poor locality data. Many of our specimens are from old collections and give only the country of origin. Preliminary evidence indicates that *C. margaritatus* varies considerably in cuticular granulation, morphometrics, and pectinal tooth counts. These differences do not appear great enough in light of the current understanding of *C. margaritatus* to warrant specific or subspecific status for the different populations.

Specimens of the old Gervais collection labeled "*Centrurus edwardsii*" (but not positively identified as his type material) and the types of *C. danieli* (Prado & Rios-Patiño) exhibit no significant differences from other Colombian material referable to *C. margaritatus*. "*Centrurus edwardsii*" has long been considered a synonym of *C. margaritatus* and it seems appropriate to regard *C. danieli* as a synonym of that species as well. Mello-Leitão (1945) separates *C. danieli* from *C. margaritatus* on the basis of the size of the subaculear tubercle and the color of the carinae of the tergites and metasoma. Both of these characteristics exhibit considerable variability in *C. margaritatus* throughout its range, and the characters exhibited by *C. danieli* fall within the normal range of variation of *C. margaritatus*.

Our examination of the holotype of *Centruroides argentinus* has revealed it to be a subadult female of *C. margaritatus*. Since Werner's original description of *C. argentinus*, a considerable amount of work has been done on the scorpion fauna of Argentina (Maury 1979 and included references); however, the type remains the only known specimen from that country. Two characteristics of the type specimen are noteworthy: (1) the movable finger of the pedipalp chela bears eight oblique rows of granules plus a short apical row of four granules, and (2) the size, shape, and angle of the subaculear tubercle are identical to those of *C. margaritatus*. Werner (1939) and Mello-Leitão (1945) reported that there are nine rows of granules on the chela movable finger, providing the main characteristic used to separate *C. argentinus* from *C. margaritatus*. By convention established

by earlier workers, however, the ninth (= apical) row is not counted (see Wagner 1977 for a discussion). Obviously, Werner was unaware of this convention; Mello-Leitão apparently based his key on Werner's description, rather than on examination of the type.

Specimens examined.—COLOMBIA: Antioquia, Medellin Valley (1700-1900 m), 1973 (A. B. Schneble), 1 imm. (MCZ); Bogota, 1924 (F. Apollinaire), 5 males, 3 females, RS-1072 (MNHN); no date (Linding), 1 female, RS-1131 (MNHN); Cali, 19-21 June 1948 (P. Nielsen), 1 male (ZMK); Cordoba, Cundinamarca, June 1952, 1 female (IB-Sc-513); Coyaima, Sept. 1944 (R. A. Stirton), 1 female (CAS); Tolima, Coyaima (450 m), Dec. 1944 (R. A. Stirton), 2 females (CAS); Magdalena (Prov. El Banco), no date (W. Cannon), 1 female (AMNH); Popayan, no date (Joannis), 1 male, 2 females, RS-1148 (MNHN); Villavieja, Mar. 1945, 1 imm. male (CAS); no specific locality, date, or collector, 4 males, 2 females RS-1075 (MNHN); 1 female, 1 imm. (AMNH); no specific locality, 28 Sept. 1900 (M. Andre), 1 female RS-1104 (MNHN); Dec. 1973 (A. Negett), 1 female (MNHN). ECUADOR: Balzapamba, June 1938, 1 female (CAS); Guayaquil, 4 males, 1 female (RS-1122); vic. Guayaquil, 1 female (CAS); Guayaquil, no date (Reiss), 2 males, 3 females, 1 imm. female (ZMB); Guayaquil, 10 males, 18 females, 7 imm. (ZMB); Guayaquil, 4 Mar. 1964 (R. O. Schuster), 1 male, 1 female, 26 neonates (CAS); vic. Guayaquil, Feb. 1959, 1 female (CAS); Isla Puná, no date (M. Souleyet), 1 female holotype, RS-1051 (MNHN); Isla Puná, 9 Nov. 1950 (E. S. Ross, A. E. Michelbacher), 1 male, 1 female, 1 imm. female (CAS); Quito, ?1907 (Vorbeck), 1 male (ZMK); Riobamba, ?1901 (Rivet), 1 female, RS-1146 (MNHN); Vallee de Tabacundo (Prov. Quito), May 1884, 1 male, RS-1150 (MNHN). PERU: no specific locality, date, or collector, 2 males, 5 females, RS-1124 (MNHN); ?1901 (Baer), 1 male, 1 female, RS-3336 (MNHN). VENEZUELA: Ciudad Bolivar, ?1901 (Baer), 4 females, RS-3375 (MNHN); Guanoco (Depto. Sucre) (Beebe), 1 female, 70 neonates (AMNH).

Centruroides exsul (Meise, 1934)

Figs. 32-39

Centruroides luctifer Marx 1890:211. **NOMEN NUDUM.**

Isometroides aequatorialis Marx (?): label name in the U.S.N.M., **NOMEN NUDUM.**

? *Androctonus americanus*, Butler 1877:75.

Centrurus princeps, Banks 1902:68; Kraepelin 1899:95.

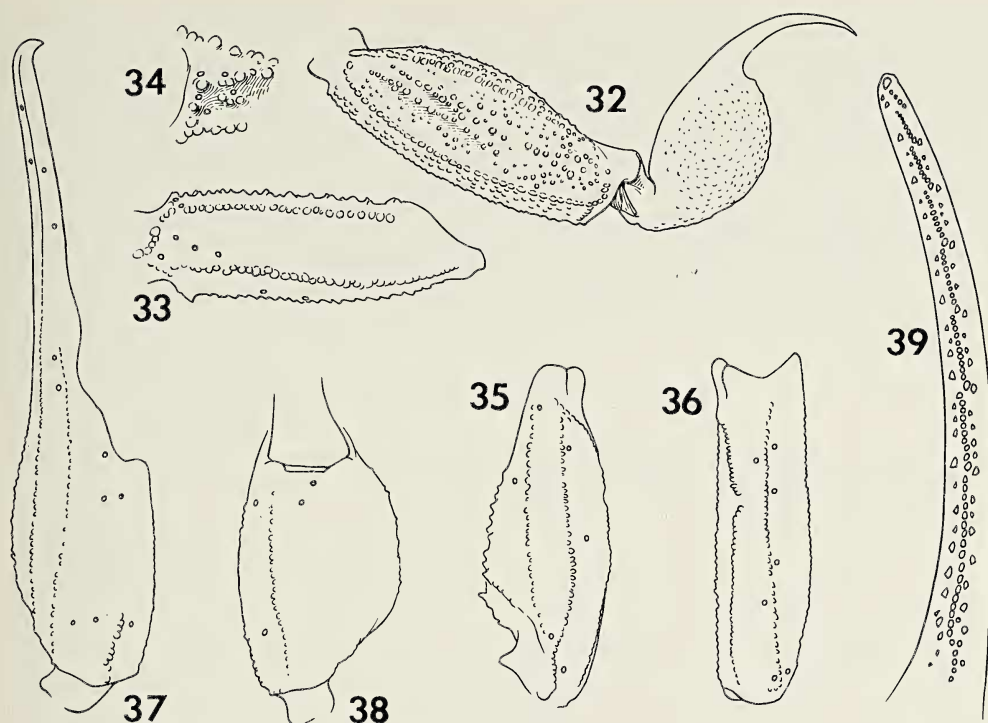
Rhopalurus testaceus exsul Meise 1934:25.

Centruroides exsul, Mello-Leitão 1945:255; Roth & Craig 1970:119; Kinzelbach 1973:2; Sissom & Francke 1983:1.

Type data.—Holotype female and four paratypes (1 male, 1 female, and 2 immatures) from Isla Floreana, Post Office Bay, Galápagos Islands (A. Wollebaek, coll.), Sept.-Oct. 1925. Deposited in the Zoologisk Museum, Oslo; examined.

Distribution.—Known from the following islands in the Galápagos Archipelago: Abingdon (= Isla Pinta); Bindloe (= Isla Marchona); Charles (= Isla Santa María, Isla Floreana); Chatham (= Isla San Cristobal); Hood (?) (= Isla Española); and Indefatigable (= Isla Santa Cruz, Isla Chavez). We have also seen specimens from Peru, but the species probably does not occur there naturally.

Description.—Smaller species of *Centruroides*, adults 40-55 mm in length. Color uniformly reddish yellow to reddish brown, lacking dorsal stripes on the mesosomal tergites. Carapace, post-tergites, and intercarinal spaces of metasoma and pedipalps densely, coarsely granular. Median carina of tergites I-VI strong, granular; tergite VII pentacarinat, all five keels strong, crenulate to serrate. Sternite VII tetracarinat, all keels moderate, granular. Pectinal tooth count 21-32 (mode = 26) in males, 19-24 (mode = 23) in females; female basal pectinal piece with small central depression. Metasomal segments of adult males more or less



Figs. 32-39.—Morphology of male paratype of *Centruroides exsul* (Meise): 32, metasomal segment V and telson; 33-38, trichobothrial pattern of pedipalp (see legend of *C. gracilis* for explanation); 39, movable finger of pedipalp chela showing dentition.

equal in length to those of female. Metasomal carinae on I-IV moderate to strong, crenulate to serrate; metasomal segment V (Fig. 32) pentacarinate. Telson vesicle irregularly granular; subaculear tooth obsolete to vestigial (Fig. 32). Dorsal marginal, dorsal secondary, ditigal, ventroexternal, and dorsointernal carinae of pedipalp chela strong, granulose; external secondary carina vestigial, granulose distally. Fixed finger with 7-8 oblique rows of granules; movable finger (Fig. 39) with 7-8 such rows plus a short apical row of 3-4 granules; supernumerary granules present in older instars. Orthobothriotaxia A, with α configuration (Figs. 33-38) (Vachon 1973, 1975). Cheliceral fixed finger with one ventral nodule.

Variability.—Variation in pectinal tooth counts and pedipalp chela finger dentition are summarized in Tables 2 and 3, respectively. Kinzelbach (1973) reported a variability of 7-12 rows of granules on the chela fingers for this species, with the high counts occurring on Abingdon, Chatham, and Charles Islands. We have seen only 7-8 rows on the fixed finger and 7-8 rows on the movable finger on all specimens we have examined, including those from Charles and Abingdon Islands. Further, the possession of 12 rows is unknown in *Centruroides*; therefore, Kinzelbach's report is apparently in error.

Comments.—The type material is in good condition, although coloration is somewhat faded in alcohol. The pectines of the male paratype are destroyed. Measurements of the holotype female and the paratype male are given in Table 1.

Specimens examined.—GALÁPAGOS ISLANDS; *Isla Floreana*, Post Office Bay, Sept.-Oct. 1925 (A. Wollebaek), holotype female, 1 male, 2 females and 2 juv. paratypes (ZMO); 19 Aug. 1975 (C.

Ribera), 1 male, 1 juv. (UB); *Indefatigable Is.*, Academy Bay, Dec. 1968 (A. and J. DeRoy), 1 juv. (CAS); *Isla Marchona*, Cabo Espijo Camp (10 m, dry *Bursera* litter, under box in camp), 27 Jan. 1978 (W. G. Reeder), 1 juv. (UT); *Isla Pinta*, South coast, 25 May 1964 (D. Q. Cavagnaro), 4 males, 1 female, 11 juvs. (CAS); South slope (400 m, under small lava rocks and decaying wood), 19 July 1977 (W. G. Reeder), 1 juv. (UT); (400 m, night collection on *Xanthoxylum* and basal rock outcrop), 20 July 1977, 1 male (UT); (250 m, under rock, *Pisonia* coppice), 20 Jan. 1977, 1 male (UT); (at night, rocky outcrop), 1 female (UT); South Playa (5 m, under driftwood on lava shell beach), 21 Jan. 1977 (W. G. Reeder), 1 juv. (UT); 16 July 1977, 1 male (UT); *Isla Santa Cruz*, Academy Bay (under stones), 23 Aug. 1968 (A. and J. DeRoy), 1 female (CAS); Academy Bay, Darwin Research Station, 8 Feb. 1964 (Schuster), 1 juv. (CAS); no date (Cavagnaro and Schuster), 1 female (CAS); Table Mountain (440 m), 16 Apr. 1964 (D. Q. Cavagnaro), 5 females, 1 juv. (CAS). PERU: no specific locality, no date (M. Eydoux), 1 male, 1 female, RS-1111 (MNHN).

Centruroides dasypus Mello-Leitão, 1948

Centruroides dasypus Mello-Leitão in Mello-Leitão & Araújo-Feio 1948:316; Aquilar & Meneses 1970:3; Stahnke & Calos 1977:112; Francke 1977:75.

Type data.—One male holotype, 1 female allotype, and 3 female paratypes from Andahuaylas, Perú (3000 m), W. Weyrauch, coll. Deposited in the Museu Nacional, Rio de Janeiro; examined.

Comments.—Since its original description (Mello-Leitão 1948), *Centruroides dasypus* has been considered a rather unique species in South America, known only from the type locality. Examination of this material has led to the clarification of the identity of *C. dasypus*. The following evidence will clearly establish that *C. dasypus* is a junior synonym of *Centruroides vittatus* (Say) from south-central USA and northern Mexico.

Color pattern.—Although the color pattern is somewhat faded in alcohol, specimens of *C. dasypus* possess the same distinctive pattern as *C. vittatus*. The mesosoma bears a pair of darkened, longitudinal, submedian stripes, which extend into the posterolateral regions of the carapace. The interocular triangle of the carapace is conspicuously darkened and offset from the surrounding areas on the carapace, as in *C. vittatus*. Finally, the ventral aspect of the metasoma has a dark median stripe, and the pedipalp chela fingers are the same color as the chela manus. Although color variation in *C. vittatus* is great, this particular combination of color characteristics (particularly the offset interocular triangle) is definitely the most common pattern observed.

Pedipalp chela finger dentition.—Mello-Leitão (1948) reported seven rows of granules on the chela fingers of *C. dasypus*, a characteristic which has made *C. dasypus* distinct among *Centruroides* spp. (see, for example, the key of Stahnke & Calos 1977). However, in *Centruroides*, the two basal rows of granules are frequently fused (Wagner 1978, Francke & Sissom 1980). Therefore, a species which normally has eight rows of granules would appear to have only seven, and this is precisely the case for *C. dasypus*. The female allotype of *C. dasypus* has "seven" rows on the left chela; however, it clearly has eight rows on the right chela, a fact apparently missed by Mello-Leitão (1948). The holotype male has eight rows on both chelae. The possession of eight rows on the chela fingers is widespread in *Centruroides* and occurs in *C. vittatus*.

Legs.—Mello-Leitão (1948) reported that the tarsi of *C. dasypus* are very pilose, and that this distinguishes the species from others in the genus. This statement is not true, and the pilosity of the tarsi of *C. dasypus* is not different from that of *C. vittatus* or many other species in the genus.

We have also found *C. dasypus* to be virtually identical to *C. vittatus* in trichobothrial pattern, size and shape of the subaculear tubercle, and in carinal development of the pedipalps, metasoma, tergites, and sternite VII. The specimens of *C. dasypus* exhibit slightly lower pectinal tooth counts than the average value observed in *C. vittatus*, but this can be attributed to sampling error. The types of *C. dasypus* also exhibit smaller body size than the typical *C. vittatus*, but the latter exhibits a wide range of adult body size throughout its range and even within populations (W. D. Sissom, pers. obs.). The differences in these last two features cannot be considered important as species characters. An additional point to consider is that the striped forms of *Centruroides* possessing eight subrows on the pedipalp chela fingers are restricted to the United States, México, and the Caribbean (with the exception of *C. thorelli*, which occurs as far south as Costa Rica).

Conclusions.—The evaluation of the above taxonomic characters has demonstrated that *C. dasypus* is not a valid species. We hereby propose the following synonymy: *Centruroides vittatus* (Say, 1821) = *Centruroides dasypus* Mello-Leitão, 1948.

The occurrence of *C. vittatus* at Andahuaylas, Perú is very difficult to explain, as this locality is deep in the Andes in the province of Apurímac. Although we have seen North and Central American specimens of *Centruroides* which apparently were introduced to South America (most are from port cities), it seems doubtful that the Andahuaylas record is an introduction. We suspect, instead, that the record is the result of a labeling error.

Specimens examined.—PERU: Andahuaylas (3000 m), (W. Weyrauch), 1 male holotype, 1 female allotype, 3 females paratypes of *C. dasypus* (MNRJ).

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